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INFLUENCE OF COGNITIVE STYLES ON SECONDARY SCHOOL STUDENTS' INTEREST AND ACADEMIC ACHIEVEMENT IN CHEMISTRY IN ANAMBRA STATE

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Abstract

Cognitive styles refer to the characteristic ways in which individuals process information, perceive, think, learn, and solve problems. This study investigated the influence of cognitive styles on students' interest and academic achievement in Chemistry in Anambra State. Six research questions were answered and six null hypotheses were tested at a 0.05 level of significance in the study. The design of the study was an ex-post-facto research design. The population of the study was 7,833 public senior secondary two (SSII) students in Anambra State. The sample consisted of 303 students (123 boys and 180 girls) from six intact classes of six public coeducational secondary schools in Aguata Education Zone, Anambra State. Three instruments were used for data collection: the Grouped Embedded Figure Test, which was used to categorize students into different cognitive styles, including dependent and independent cognitive styles; the Chemistry Interest Scale; and the Chemistry Achievement Tests. Three experts validated the instruments, and the reliability coefficients were 0.72 and 0.89, respectively. Research questions were answered using mean and standard deviations while the hypotheses were tested using t-test and analyzing of variance (ANOVA) at 0.05 level of significant. Findings, among others, revealed no significant difference between the mean achievement scores of field-dependent and field-independent students with a cognitive style in Chemistry. Additionally, there is no significant difference in the mean interest response between field-dependent and field-independent cognitive styles in Chemistry. Based on this, it was recommended, among other things, that the Chemistry curriculum be planned in such a way that the teacher can monitor the cognitive styles of students. Education authorities should encourage Chemistry teachers and teacher education institutions to incorporate cognitive style into the curriculum content.

Keywords: Influence, Cognitive Styles, Students, Interest, Academic Achievement, Chemistry

1.1 Introduction

Education performs multiple roles in contemporary society, including the preservation, transformation, transfer, and advancement of knowledge. It is also a vehicle for positive societal change. Its significance lies in its role as a key driver in strengthening human capital for sustainable social and economic progress. This aligns with Nigeria's Vision 2020, which identifies education and training under the social pillar as a vital platform for transforming the nation into a strong, diversified, sustainable, and competitive economy that maximizes talent, empowers its people, and responsibly utilizes its natural resources to ensure a high standard of living and quality of life for

citizens (Ezeugo, Okafor & Ikeanumba, 2025). The sustainable development of any country largely depends on the scientific and technological literacy of its population (Selvarani & Saroja, 2022). In today's world, there is a pressing need to prioritize scientific and technological advancement due to their rapid global growth. Consequently, students are being encouraged to cultivate an interest in science and pursue science-related subjects and courses, as this will significantly accelerate progress in these critical areas in the future (Algani, 2022). In this regard, Chemistry plays a central role.

Chemistry holds a vital place in the sciences as it offers the foundational principles needed to understand complex chemical reactions that drive industrial production of various goods essential for human welfare and technological advancement, especially in developing nations such as Nigeria. Disciplines such as medicine, engineering, and other related fields rely heavily on knowledge of Chemistry for their effective practice. Okoli and Echekwe (2021) described Chemistry as the scientific study of the composition, properties, and behavior of organic, inorganic, and elementary forms of matter. According to Friedl (2018), Chemistry is the science of structure, order, and relationships, which developed from basic practices such as counting, measuring, and observing shapes. Meyer (2018) explained Chemistry as the study of matter's properties, characteristics, and its physical and chemical transformations. Ugwu (2019) emphasized that Chemistry is an experimental discipline requiring the integration of theory and practice for effective understanding, development, and application of concepts. Drawing from the perspectives of Ajayi, Friedl, Meyer, and Ugwu, the researcher infers that Chemistry focuses on the composition and structure of matter, as well as the forces that bind these structures together.

Chemistry is broadly divided into three major branches: physical, inorganic, and organic Chemistry. Physical Chemistry focuses on the study of both macroscopic and microscopic phenomena in chemical systems, explained through principles of physics such as motion, energy, force, time, thermodynamics, quantum Chemistry, statistical mechanics, and chemical equilibrium (Okoli & Echekwe, 2021). The authors continued that inorganic Chemistry is concerned with the synthesis and properties of inorganic and organometallic compounds, primarily involving substances that are not carbon-based. Organic Chemistry, on the other hand, examines the structure, properties, composition, reactions, and synthesis of carbon-containing compounds, including hydrocarbons as well as compounds that incorporate elements such as hydrogen, oxygen, and nitrogen. Chemistry, as detailed by Chibuisi (2023), involves concepts that require higher-order mental processes, such as visualization, manipulation, analysis, abstraction, and the association of ideas. Its teaching fosters the development of several transferable skills, including problem-solving, model-based thinking, and awareness of hazards. This aligns with the objectives of secondary school Chemistry education, which emphasize the application of acquired skills to address societal needs, including job creation and wealth generation (Federal Republic of Nigeria [FRN], 2013). When effectively taught, Chemistry strengthens students' conceptual understanding and analytical skills, enabling them to tackle real-life challenges such as global economic crises and pandemics, while also stimulating their interest in the subject.

Interest, according to Nwanze and Okoli (2021), is defined as students' orientations towards activities that are intended to develop academic skills and knowledge, which is considered a crucial variable contributing to various aspects of student learning and sustained attention. In psychology, interest, according to Mbaegbu (2023), refers to both the psychological state of engagement and a relatively enduring predisposition to reengage particular content over time. Interest positively

influences attention, goal setting, and learning strategies for people of all ages, both in and out of school (Nweke, 2021). It is a robust motivational process that energizes learning, guides academic and career trajectories, and is essential to academic success. Interest, therefore, is both a psychological state of attention and affection towards a particular object or topic, and an enduring predisposition to reengage in it over time. The lack of interest among science students in the subject is known to hinder academic progress (Idah, 2018). The underlying mechanism is that academic interest affects achievement through higher effort and perseverance in learning, demonstrating an additive effect in addition to cognitive ability, which enhances achievement by facilitating quicker and deeper understanding. When interest is lacking, students may become passive learners and may have other priorities that compete for their time and attention. Individual students, as Reninnger and Hidi (2016) noted, may suffer from physical, mental, or other personal problems that affect motivation. A student's lack of interest may also lead to a poor conceptual understanding, which can result in poor academic achievement.

Academic achievement, according to Berkley and Chang (2022), refers to the extent to which a student, teacher, or institution has attained the short or long-term educational goals. It describes academic outcomes that indicate the extent to which a student has achieved their learning objectives (Inyang, 2022). Achievement is often measured through standardized or teacher-made tests and typically denotes a student's grade on an examination or test. To improve students' achievement, there is a general agreement among researchers and authors that teachers must adopt innovative teaching methods that centre instruction on the students. Agu, Ezeugo, and Okafor (2025) defined it as the gain in knowledge a student experiences as a result of participating in a learning activity or program. Academic achievement may be defined as a statistical report of a student's performance in an engaged educational (academic) program. Most studies carried out in Nigeria have asserted that the academic achievement of learners depends primarily on their hard work and the interaction between personal (psychological) and environmental variables involved in the learning process. Academic achievement, as explained by Ezeugo, Okafor and Ikeanumba (2025), refers to an individual's performance in cognitive tasks. The authors further explained that it is the general ability of students in relation to their performance in school subjects compared to a specified standard, known as the 'pass mark'. In addition, academic achievement refers to the observed and measured aspects of a student's mastery of skills and subject matter as measured with valid and reliable tests (Mbaegbu, 2017). Academic achievement is typically used to describe an individual's performance in subjects taught and assessed in schools. It also refers to the level of education ultimately attained by an individual (Mbaegbu, Ikeanumba & Anazodo, 2023). Esomonu and Ikeanumba (2021) observed that students with high academic achievement are more likely to feel convinced and satisfied than those with poor academic achievement. Additionally, students who achieve higher academic standards tend to feel more confident, whereas those who lack confidence in themselves tend to record lower academic achievement.

The Chief Examiner's Report over the last decade has shown that students have consistently under-performed in the Chemistry May/June West African Senior School Certificate Examination (WASSCE). This leads to poor performance in student achievement. The analysis of students' achievement in Chemistry in the May/June West African Senior School Certificate Examination (WASSCE) revealed 38.50%, 35.66%, 51.73%, 56.17%, 47.39%, 46.87, 44.93 and 50.52 in 2018, 2019, 2020, 2021, 2022, 2023, 2024 and 2025 respectively; thus, Chemistry pass rate remains as low as 46.47% in the last decade (Chemistry WAEC Chief Examiner, 2018-2025). This fluctuating

performance has been of great concern to Chemistry educators over the years. Students perceive Chemistry as a complex subject because they do not understand the thought processes that underlie problem-solving in Chemistry. It has been reported that students avoid science courses due to their fear of Chemistry. This failure in education implies that Nigeria will face shortages in the workforce in science and technology-related disciplines, such as medicine, pharmacy, nursing, biochemistry, biotechnology, nanotechnology, and many other areas. Consequently, Nigeria's vision to become one of the 20 industrialized nations in the world by the year 2025 has been crippled. The differences in academic achievements of students can be attributed to various factors, including intelligence, creativity, self-esteem, cognitive style, achievement motivation, instructional strategy, self-efficacy, gender, personality, and many others (Ezeugo, Okafor & Ikeanumba, 2025). In this study, therefore, the influence of cognitive styles on the interest and academic achievement of secondary school students in Chemistry, as related to gender, was investigated.

Gender, as described by Kanno (2018), is an analytical concept that explains the sociological roles, cultural duties, and expectations assigned to men and women within a particular society or cultural context. Similarly, Mbaegbu, Ikeanumba, and Anazodo (2023) noted that gender encompasses personality traits, attitudes, behaviors, values, levels of power and influence, as well as the roles and expectations (masculinity and femininity) that society differentially assigns to the two sexes. In the view of Okoli and Echekwe (2021), gender is a socio-cultural construct that reflects the distinct responsibilities and roles of men and women in a given society. This implies that gender determines the position individuals occupy in relation to political, cultural, social, and economic structures. From the researcher's perspective, gender is a cultural construct created by society to distinguish between the roles, behaviors, and emotional and mental attributes typically associated with males and females. Gender has been recognized as a significant factor influencing students' performance in science, particularly Chemistry (Omiko, 2017). Esomonu and Erutujiro (2024) highlighted that in Nigeria, women often face marginalization while men enjoy greater opportunities for advancement, especially in science-related fields. This imbalance tends to provide males with an unfair advantage over their female counterparts. Alabi (2014) further reported that women are constrained by gender discrimination, early marriage, and childbearing, which limit their access to quality education, job opportunities, and broader societal participation. Findings from previous studies on gender differences in Chemistry achievement remain inconsistent. For instance, Esomonu and Ikeanumba (2021) and Agu, Ezeugo, and Okafor (2025) found no significant difference in achievement between males and females in Chemistry. Conversely, Igoegwu and Okonkwo (as cited in Ezike, 2018) and Idika (2017) revealed significant differences in both achievement and interest in Chemistry, favoring male students. Ubani (2020) argued that school subjects in Nigeria are sex-stereotyped, with Mathematics, Physics, and Chemistry considered masculine, while subjects such as English, Home Economics, and Economics are seen as feminine. He further observed that within these stereotypes, topics requiring higher-order cognitive skills tend to advantage male students.

In light of these findings, the researcher aimed to investigate the combined influence of cognitive styles and gender on the interest and achievement of secondary school students in Chemistry. Considering students' cognitive styles in teaching is therefore essential.

Cognitive style is a term used to describe the way individuals perceive, think and remember information (Chibuisi, 2023). It represents the individual differences in the various subcomponents

of an information-processing model of three main cognitive processes: perception, memory, and thought. Cognitive style is a component of a larger concept termed learning style. Learning style highlights the characteristic cognitive, affective, and psychomotor behaviors displayed by an individual as they learn. Learning style explains how any two learners who are taught the same concepts would differ in the way they learn as a result of various stimuli, including: environmental (example, noise, temperature and design); emotional (example. motivation and persistence); sociological (example, pairing and grouping); physical (example, auditory, visual or kinaesthetic); and psychological (e.g. global or analytic in approach, impulsive or reflective) (Chibuisi, 2023). Cognitive style is a psychological concept that emphasizes the fact that learners approach learning tasks with unique qualities or attributes, which can be physical, social, or intellectual, among others. These qualities play a vital role in their learning. It is an individual's most consistent approach to learning and information processing. It naturally influences how an individual perceives, receives and processes information (Zeeb, 2014).

The cognitive styles of an individual encompass both internal and external features. Internally, they are structured contents of thought and experience in one's mind. Externally, they are outward expressions of thought in terms of flow of logic, arrangement of symbols (writings, drawings, among others), use of language and relations between these facets. Consequently, cognitive styles influence the decisions and choices made by both learners and teachers during the teaching and learning process. In education, understanding cognitive styles is essential because they influence students' learning preferences, achievement, and motivation (Evans, Cools, & Charlesworth, 2020). Teachers who align instructional methods with learners' cognitive styles often facilitate better comprehension and retention. However, some scholars caution against rigidly matching teaching methods to cognitive styles, arguing instead for flexible strategies that promote adaptability (Zhang, 2018). Learning can occur in diverse ways. Therefore, there are different cognitive style dimensions, including field divergent/convergent, field dependent/independent, holistic/sequential, reflective/impulsive, and global/analytic cognitive styles. Idika (2017) argued that all cognitive styles are subordinate to, and reflect, a broad, superordinate stylistic (analytic-holistic) difference. Idika maintained that cognitive styles could be grouped into two majorly categories: wholist-analytic and verbal-imagery. The wholistic-analytic cognitive style concerns whether an individual tends to process information in wholes or in parts; the verbal-imagery pertains to whether an individual has a propensity to signify information while thinking verbally or does so in mental pictures (Idika, 2017).

The most widely investigated cognitive styles are field-dependent and field-independent. Field-dependent cognition refers to the degree to which an individual can distinguish and separate elements embedded in complex settings (Adams, 2021). Field-dependent learners tend to process information more holistically and rely more on external references (Hinckley & Alden, 2023). They succeed in situations where structure is provided for them and tend to solve problems through intuition and trial-and-error approaches. In contrast, field-independent personalities approach the environment in a highly analytical manner, such as distinguishing figures from their surroundings. The mental schemas of this set of people entail multiple accessibility. Studies (Ezike, 2018; Kanno, 2018) have found that cognitive styles have a significant effect on students' achievement in Chemistry. On the contrary, Garton, Spain, Lamberson and Spiers (2020) found a low positive relationship between cognitive style and students' achievement. Moreover, other researchers have investigated the impact of cognitive style and gender on students' achievement in various sciences.

Ogan (2022) suggested that field-independent students achieve higher scores in mathematics than field-dependent students. Similarly, Okoye (2016) documented that gender and cognitive styles have no significant influence on achievement scores of students in biology. Oludipe (2024) reported that most students are analytic, and a significant difference in physics achievement was found in favour of analytic students. Cognitive style helps students identify the best situation for their learning, which in turn increases their achievement.

1.2 Statement of the Problem

Chemistry, as a core science subject, plays a vital role in the scientific and technological development of any nation. In Nigeria, and particularly in Anambra State, the subject is an essential requirement for students aspiring to pursue careers in medicine, engineering, pharmacy, agriculture, and other science-related fields. Despite its importance, evidence from the West African Examinations Council (WAEC) and the National Examinations Council (NECO) over the years has shown that students' performance in Chemistry remains consistently poor. Several factors have been linked to this underachievement, including the abstract nature of the subject, inadequate teaching methods, and lack of student interest. One important but often neglected factor that may explain students' low interest and poor achievement in Chemistry is cognitive style, which is the characteristic way in which learners perceive, process, and retain information. Students differ in their preferred learning styles, ranging from field-dependent to field-independent, and from analytic to holistic, as well as from verbal to visual. A mismatch between the teacher's instructional approach and the learner's cognitive style may lead to reduced interest, poor comprehension, and low achievement. Conversely, when instruction aligns with students' cognitive styles, they are more likely to develop interest and achieve better learning outcomes.

In Anambra State, Chemistry teachers frequently adopt uniform teaching methods without considering individual differences in learners' cognitive styles. This raises concerns that such practices may contribute to students' declining achievement and waning interest in the subject. Moreover, little to no research has been conducted within the state to empirically investigate how cognitive styles influence students' interest and academic achievement in Chemistry. Without such knowledge, efforts by teachers, curriculum planners, and policymakers to improve Chemistry education may remain ineffective. It is against this backdrop that the present study aimed to investigate the influence of cognitive styles on students' interest and academic achievement in Chemistry in Anambra State.

1.3 Research Questions

The following research questions guided the study

1. What are the mean achievement scores of field-dependent and field-independent students in Chemistry?
2. What is the mean interest response of field-dependent and field-independent students in Chemistry?
3. What are the mean achievement scores of male and female students in Chemistry based on cognitive style?
4. What are the mean interest scores of male and female students in Chemistry based on cognitive style?

5. What are the mean achievement scores of field-dependent and field-independent students in Chemistry based on gender?
6. What are the mean interest scores of field-dependent and field-independent students in Chemistry based on gender?

1.4 Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of field-dependent and field-independent students in Chemistry.
2. There is no significant difference between the mean interest scores of field-dependent and field-independent students in Chemistry.
3. There is no significant difference between the mean achievement scores of male and female students in Chemistry based on cognitive style.
4. There is no significant difference between the mean interest scores of male and female students in Chemistry based on cognitive style.
5. There is no significant difference in the mean achievement scores of field-dependent and field-independent students in Chemistry based on gender.
6. There is no significant difference in the mean interest score between field-dependent and field-independent students in Chemistry, based on gender.

2. Materials and Methods

The design of the study was an ex-post-facto research design. The population of the study was 7,833 public senior secondary two (SSII) students in Anambra State. The sample consisted of 303 students (123 boys and 180 girls) from six intact classes of six public coeducational secondary schools in Aguata Education Zone, Anambra State. Three instruments were used to collect data: the Grouped Embedded Figure Test was used to categorize students into different cognitive styles, including dependent and independent cognitive styles; the Chemistry Interest Scale; and the Chemistry Achievement Tests. Three experts validated the instruments and the reliability coefficients of the instruments were 0.72 and 0.89 respectively. Research questions were answered using mean and standard deviations while the hypotheses were tested using t-test and analyzing of variance (ANOVA) at 0.05 level of significant.

3. Results

Research Question 1: What are the mean achievement scores of field-dependent and field-independent students in Chemistry?

Table 1: The Mean Achievement Scores of Students with Field-Dependent and those with Field-Independent and their Standard Deviations in Chemistry

Cognitive Styles	N	Mean	Std Deviation
Field-Dependent	127	60.48	10.535
Field-Independent	176	62.34	11.657

Table 1 shows that the mean achievement scores of students with field-dependent and those with field-independent cognitive styles in Chemistry are 60.48 and 62.34, respectively, with

standard deviations of 10.54 and 11.66. This implies that a field-independent cognitive style positively influenced students' achievement in Chemistry more effectively than a field-dependent cognitive style. To determine whether the difference is significant, the mean achievement scores are subjected to an independent t-test analysis, as shown below.

Hypothesis 1: There is no significant influence difference in the mean achievement scores between dependent and field independent students in Chemistry.

Table 2: t-test Analysis on the Mean Achievement Scores of Field Dependent and Field Independent Students in Chemistry

Group	N	Mean	Std. Dev.	t-cal	P-value	Decision
Field-Dependent	127	60.48	10.535	-1.422	0.156	NS
Field-Independent	176	62.34	11.657			

Table 2 shows that the calculated t-value of 1.422 at 302 degrees of freedom is higher than the p-value of 0.156 and, therefore, is not significant. The calculated t-value is found to be significant at 0.156, which is greater than the significance level (0.05) set for the study. As such, the null hypothesis was not rejected. This means that there is no significant difference between the mean achievement scores of students with field-dependent and field-independent cognitive styles in Chemistry.

Research Question 2: What are the mean interest scores of field-dependent and field-independent students in Chemistry?

Table 3: Mean Interest Scores and Standard Deviation of Students with Field Dependent and those with Field Independent Cognitive Styles in Chemistry.

S/N	Items statements	Field Dependent			Field Independent		
		Mean	Std. Dev.	Remark	Mean	Std. Dev.	Remark
1.	Studying Chemistry is fun.	3.2913	.63133	Agree	3.2614	.64133	Agree
2.	The topics in Chemistry are not interesting.	3.4724	.69951	Agree	3.4318	.72183	Agree
3.	Chemistry questions are boring	3.1811	.80096	Agree	3.1534	.80306	Agree
4.	Lessons on Chemistry make me active in class	3.0709	.78862	Agree	3.0682	.79707	Agree
5.	I often communicate with my classmates using Chemistry terms	3.0472	.82480	Agree	3.0398	.82366	Agree
6.	I hardly discuss Chemistry problems with my classmates during free periods	2.9370	.68716	Agree	2.9091	.68680	Agree
7.	I will like to study Chemistry in the university	3.2520	.76603	Agree	3.2614	.77819	Agree
8.	Answering Chemistry questions keep me thinking creatively	3.1260	.59083	Agree	3.1250	.61062	Agree

9.	Spending time answering Chemistry questions is not fascinating	3.0787	.62496	Agree	3.0739	.60493	Agree
10.	Answering questions during Chemistry class in fun	2.5512	.58701	Agree	2.5455	.59347	Agree
11.	Competing with other students for high score in Chemistry is challenging	3.3622	.72011	Agree	3.3750	.74546	Agree
12.	Any question failed in Chemistry should be left like that	3.4331	.76210	Agree	3.4545	.78426	Agree
13.	Problems on Chemistry are full of real life activities	2.7795	.56221	Agree	2.7727	.58019	Agree
14.	The teachers' explanation of Chemistry lessons is often encouraging	3.4016	.62055	Agree	3.3920	.63222	Agree
15.	Paying attention during Chemistry class is not necessary	2.8976	.62785	Agree	2.8977	.63317	Agree
16.	Encouraging other students to attend Chemistry classes is inspiring	2.4252	.98818	Agree	2.3920	1.02525	Agree
17.	I am motivated to experiment certain things at home due to my knowledge of Chemistry	3.1339	.60896	Agree	3.1250	.60119	Agree
18.	Being on time for Chemistry lessons is exciting	3.3622	.75245	Agree	3.3693	.72897	Agree
19.	Writing short notes on Chemistry as teacher is explaining is exciting	3.5512	.58701	Agree	3.5455	.59347	Agree
20.	I am always afraid whenever I am called upon to answer question on Chemistry	3.5276	.58861	Agree	3.5227	.59478	Agree
21.	Grand mean	3.1441	.30989	Agree	3.1358	.31418	Agree

As shown in Table 3, the mean interest scores of students with field-dependent and those with field-independent cognitive styles are all above 2.50, which is the decision level. This implies that both students with field-dependent and those with field-independent cognitive styles agreed that all the items of interest on the table influence their interest in Chemistry.

Hypothesis Two: There is no significant difference between the mean interest scores of field-dependent and field-independent students in Chemistry.

Table 4: t-test Analysis on the Mean Interest Scores of Students with Field Dependent and those with Field Independent in Chemistry

Group	N	Mean	Std. Dev.	t-cal	P-value	Decision
Field-Dependent	127	3.1441	0.29558	0.238	0.812	NS
Field-Independent	176	3.1358	0.30284			

Table 4 shows the calculated t-value of 0.238 with a p-value of 0.812 at 302 degrees of freedom. The obtained t-value is higher than the alpha value, hence the difference is not significant. The null hypothesis of no significant difference is therefore upheld. In other words,

there is no significant influence of cognitive styles regarding field-dependent and field-independent on students' interest in Chemistry.

Research Question 3: What are the mean achievement scores of male and female students in Chemistry based on cognitive style?

Table 5: Mean Achievement Scores and the Standard Deviation of Male and Female Students in Chemistry based on their Cognitive Styles

	Male			Female		
Cognitive styles	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
Field-Dependent	54	57.24	10.122	73	62.88	10.252
Field-Independent	69	61.35	10.029	107	62.97	12.601

As shown on Table 5, the mean achievement scores of male and female Chemistry students with field dependent are 57.24 and 62.88 with standard deviations of 10.22 and 10.25 respectively as against 61.35 and 62.97 with standard deviation of 10.03 and 12.60 of their field-independent counterpart respectively. This implies that females performed better than males in both field-dependent and field-independent. In order to know whether the difference is significant, the mean achievement scores are subjected to analysis of variance (ANOVA) as shown below.

Hypothesis 3: There is no significant difference between the mean achievement scores of male and female students in Chemistry based on their cognitive styles.

Table 6: Analysis of Variance (ANOVA) for the Mean Achievement of Male and Female Scores in Chemistry based on Cognitive Styles

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1350.410[a]	3	450.137	3.670	.013
Intercept	1065896.398	1	1065896.398	8691.507	.000
Group	315.037	1	315.037	2.569	.110
Gender	940.300	1	940.300	7.667	.006
Group * Gender	287.122	1	287.122	2.341	.127
Error	36668.329	299	122.637		
Total	1186194.000	303			
Corrected Total	38018.739	302			

As shown on Table 6, F (7.667) is significant at .006 for Gender; at 1 and 302 degrees of freedom (df). This is because .006 is less than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is rejected. Hence, there is a significant difference between the mean achievement scores of male and female students based on their cognitive styles.

Research question 4:
What are the mean interest scores of male and female students in Chemistry based on their cognitive styles?

Table 7: The mean Interest Responses of Male and Female Students in Chemistry based on their Cognitive Styles

	Male			Female		
Cognitive styles	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
Field-Dependent	54	3.12	0.29	73	3.16	0.30
Field-Independent	69	3.14	0.30	107	3.14	0.30

As shown on table 7, the mean responses of both males and females that are field-dependent are almost the same thing with that of males and females that are field-independent. The difference is just about 0.01 which seems very insignificant. Nevertheless, the result is subjected to hypotheses testing to know the level of significance.

Hypothesis 4:
$H0_4$: There is no significant difference between the mean interest scores of males and females students in Chemistry based on cognitive styles.

Table 8: Analysis of variance (ANOVA) for the Mean Interest Scores of Males and Females Students in Chemistry based on Cognitive Styles

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	.054[a]	3	.018	.199	.897
Intercept	2811.542	1	2811.542	31125.184	.000
Interest	.002	1	.002	.022	.883
Gender	.027	1	.027	.300	.585
Interest * Gender	.029	1	.029	.322	.571
Error	27.009	299	.090		
Total	3013.140	303			
Corrected Total	27.063	302			

As shown on Table 6, F (0.300) is not significant at .585 for gender, at 1 and 302 degrees of freedom (df). This is because 0.585 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is of no significant difference is upheld. Hence, there is no significant difference between the mean interest scores of male and female students based on their cognitive styles.

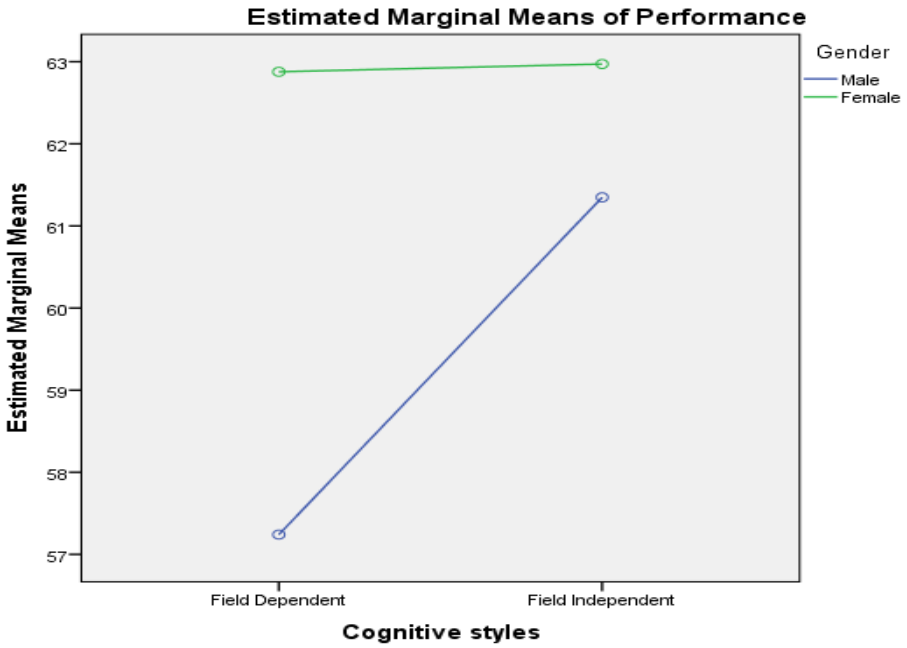
Research question 5: What are the mean achievement scores of field-dependent and field-independent students in Chemistry based on gender?

Table 9: The Mean Achievement Scores of Field-Dependent and Field-Independent Students based on Gender

Gender	**Field dependent**	**Field independent**
Male	57.24	61.35
Female	62.88	62.97

As shown on Table 9, the mean achievement scores of both males and females are higher with field independent – 61.35 and 62.97 than with field dependent - 57.24 and 62.88 respectively.

This implies that there is no joint influence of gender and cognitive styles on students' achievement in organic Chemistry. This is illustrated with graph below



Hypothesis 5: There is no significant difference between the mean achievement scores of field-dependent and field-independent students in Chemistry based on gender

Table 10: Analysis of Variance (ANOVA) for the Mean Achievement Scores of Field-Dependent and Field-Independent Students in Chemistry based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1350.410[a]	3	450.137	3.670	.013
Intercept	1065896.398	1	1065896.398	8691.507	.000
Cognitive Style	315.037	1	315.037	2.569	.110
Gender	940.300	1	940.300	7.667	.006
Cognitive Style * Gender	287.122	1	287.122	2.341	.127
Error	36668.329	299	122.637		
Total	1186194.000	303			
Corrected Total	38018.739	302			

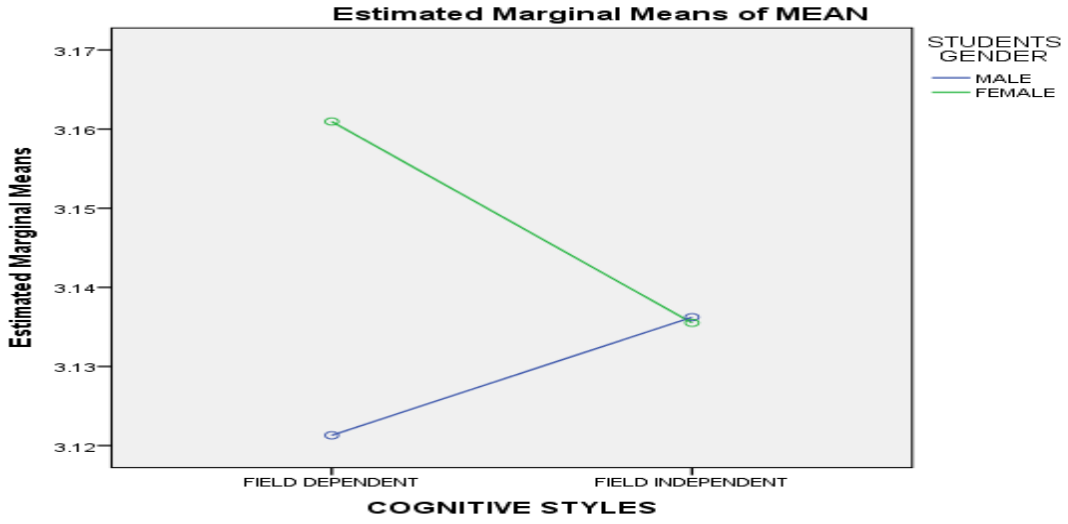
As shown on Table 10, F (2.569) is not significant at .110 for gender, at 1 and 302 degrees of freedom (df). This is because .127 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is of no significant difference is upheld. Hence, there is no significant joint influence of gender and cognitive styles on academic achievement scores of students in Chemistry.

Research Question 6: What are the mean interest scores of field dependent and field independent students in Chemistry based on gender?

Table 11: The Mean Interest Scores of Field Dependent and Field Independent Students in Chemistry based on Gender?

Gender	Field dependent	Field independent
Male	3.12	3.14
Female	3.16	3.13

As shown in Table 11, the mean interest score of male that are field independent is slightly higher than that of males that are field dependent, 3.14 as against 3.12, whilethe mean interest score of females that are field dependent is slightly higher than that of males that are field independent, 3.16 as against 3.13. This implies that there is slight joint influence of gender and cognitive styles on students' interest in Chemistry. This is illustrated with graph below.



Hypothesis 6: There is no significant difference between the mean interest scores of field-dependent and field-independent students in Chemistry based on gender

Table 12: Analysis of Variance (ANOVA) for the Mean Interest Scores of Field-Dependent and Field-Independent Students in Chemistry based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.054[a]	3	.018	.199	.897
Intercept	2811.542	1	2811.542	31125.184	.000
Cognitive Style	.002	1	.002	.022	.883
Gender	.027	1	.027	.300	.585
Cognitive Style * Gender	.029	1	.029	.322	.571
Error	27.009	299	.090		
Total	3013.140	303			
Corrected Total	27.063	302			

As shown on Table 12, F (0.022) is not significant at .883 for cognitive style and gender, at 1 and 302 degrees of freedom (df). This is because .883 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is of no significant difference is upheld. Hence, the joint influence of gender and cognitive styles on interest scores of students in Chemistry is not significant.

4. Discussion

It was indicated that students with a field-independent cognitive style achieved higher than those with a field-dependent cognitive style. The data revealed that field-independent students achieve higher than field-dependent students. The result of hypothesis testing has revealed that the difference in achievement between students with field-independent and field-dependent cognitive styles is not significant. The findings of this study align with Ogan's (2022) observation that field-independent students outperformed field-dependent students in geometry, algebra, and statistics. This result aligns with Idika's (2017) observation that students with a field-independent level of cognitive style achieved higher mean scores in Chemistry than those with a field-dependent level of cognitive style. This may be a result of students' lack of interest in Chemistry, as some view it as a challenging subject. Cognitive style does not have a significant influence on students' interest in Chemistry. It was found that the mean interest scores of students with field-dependent and those with field-independent cognitive styles are all above 2.50, which is the decision level. This implies that both field-dependent and field-independent cognitive style students agreed that all the items of interest on the table influence their interest in Chemistry. It was shown that there is no significant influence of cognitive styles on students' interest in Chemistry. This is because students were made to understand the importance of Chemistry in our daily life, that everything we use has knowledge of Chemistry in it. There is no literature within the researcher's accessibility to support these findings.

This result indicates that females tend to achieve higher scores on both field-dependent and field-independent tasks. To confirm the results, the mean achievement scores are subjected to ANOVA in Table 6, which shows a significant difference between the mean achievement scores of male and female students based on their cognitive style. The results show that female students in both field-dependent and field-independent cognitive styles score higher than males in these styles. This study is contrary to Musa and Samuel (2019), who submitted that male students in both field-dependent and field-independent groups achieve significantly higher than females. The result showed that the mean interest response of field-dependent male students was 3.12 with a standard deviation of 0.29, and the mean interest response of field-independent male students was 3.1352 with a standard deviation of 0.30. The table further showed the mean interest scores of field-dependent females and the mean interest scores of field-independent females. The confirmatory result further revealed that there is no significant difference in the mean interest scores between male and female students based on their cognitive styles.

This result showed that the mean interest responses of female field-dependent and independent individuals do not differ significantly from those of male field-dependent and independent individuals. This revealed that both males and females have an interest in chemistry, regardless of their cognitive style. There is no literature reviewed on the relationship between interest and gender based on cognitive style. It was demonstrated that the mean achievement scores of both males and females in field-independent tasks are higher than those in field-dependent tasks.

This implies that students with a field-independent cognitive style will score better than field-dependent students.

From the graph, there is no intersection of the two margins, indicating that there is no significant joint influence of gender and cognitive style on academic achievement. This is further confirmed in Table 10. Therefore, there is no significant joint influence of gender and cognitive styles on the academic achievement scores of students in Chemistry. This study showed that field-independent male and female students score higher than field-dependent male and female students. This is in line with the view of Ella and Achor (2025) that there was a significant difference between the cognitive styles of male and female science students of high ability levels. It showed the mean score of male field-dependent individuals to be 3.12 and male field-independent individuals to be 3.14, while the interest response scores of both female dependent and independent individuals were 3.16 and 3.13, respectively. It was found that the mean interest score of male field-independent individuals is slightly higher than that of male field-dependent individuals.

In contrast, the mean interest response scores of female field-dependent individuals are slightly higher than those of male field-independent individuals. The graph illustrates the intersection of the two margins, indicating a slight influence of gender and cognitive styles on the interest of Chemistry students. The joint influence of gender and cognitive styles on students' interest scores in Chemistry is not significant. This study showed that the joint influence of gender and cognitive styles on students' interest in Chemistry is not significant.

5. Conclusion

Understanding the cognitive styles of students in the classroom during the teaching and learning of Chemistry can help increase students' achievement and interest in the Subject. The cognitive styles of students have no significant influence on their academic achievement. Field-independent students achieve higher than field-dependent students. Gender has a significant influence on achievement, particularly in relation to cognitive style. Field-independent students, regardless of gender, tend to achieve higher scores than field-dependent individuals. Gender has no significant influence on students' interests. Both field-dependent and field-independent students have an interest in Chemistry. There is no significant joint influence of gender and cognitive styles on academic achievement and interest in Chemistry.

6. Recommendations

The following recommendations are based on the findings of this study.

1. During teaching and learning, male and female cognitive styles should be considered. Male and female students should be made to understand that they have equal abilities for learning.
2. The chemistry curriculum should be planned in a way that allows the teacher to monitor students' cognitive styles and learning preferences, enabling them to tailor instruction accordingly.
3. Education authorities should encourage Chemistry teachers and teacher education institutions to incorporate cognitive style into the curriculum content.
4. The federal and state ministries of education should organize seminars and workshops for Chemistry teachers.
5. Further research should be carried out on other cognitive styles.

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